

ECG Quiz

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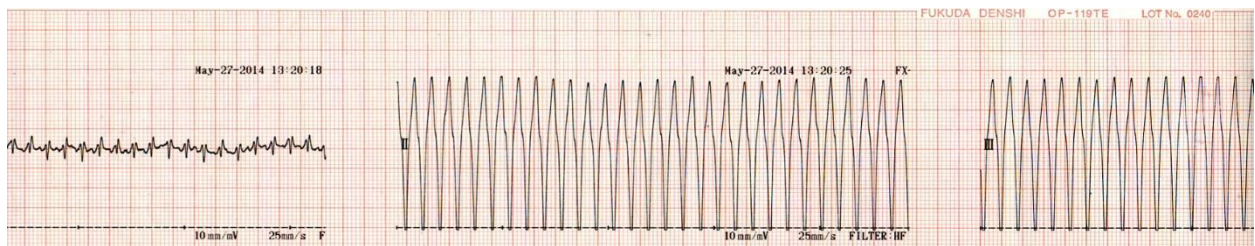


Figure 1 ECG recordings from lead I, II and III

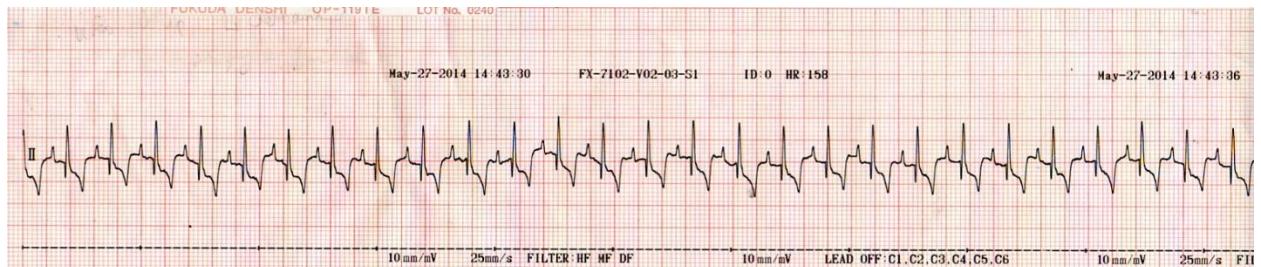


Figure 2 ECG recording after lidocaine administration

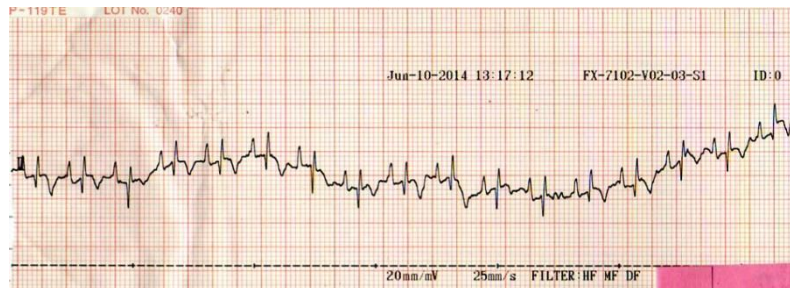


Figure 3 ECG recording 13 days after amiodarone treatment

A seven years old female mixed breed dog weighing 17.3 kilograms was presented to Small Animal Teaching Hospital, Faculty of Veterinary Science, Chulalongkorn University with symptoms of

lethargy and unalert. Both hindlimbs became weakness for the last 2 months. The dog was treated previously with antibiotic, analgesic and prednisone. The snap 4 Dx showed positive for *Ehrlichia canis*. The

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complete blood count showed normal values of RBC and WBC profiles. The biochemical data showed increases in liver enzyme; alanine aminotransferase (ALT) of 168 unit and alkaline phosphatase (ALP) of 171 unit. The BUN and creatinine were within the normal limit. Blood gas showed normal blood pH, normal oxygen and bicarbonate contents and electrolytes (Na, K and Cl) concentrations. While presenting in the hospital, the dog stayed mostly in lateral recumbency. The tachycardia was noticed from auscultation. The soft tissue swelling of dorsal thorax (13 cm in length) with bulging and round border of left ventricle were seen from thoracic radiograph. The spondylosis was found between T12-T13 with urine retention. The ECG was recorded and lead I, II and III were showed in figure 1. The dog was transferred to ER and the bolus of lidocaine was infused at the dose

of 1.6 mg/kg followed by continuous infusion at a dose of 25 ug/kg/min for approximately 2 hours. The ECG recorded immediately after lidocaine infusion was shown in figure 2. The amiodarone was given to the dog orally to control arrhythmia on the next day. Echocardiography results revealed thickening of both left and right ventricular free wall with pulmonic valve regurgitation. The LA/Ao was also elevated (2.12) with low fractional shortening (25%). Dog was treated with doxycycline and positive inotrope along with amiodarone. The loading dose of amiodarone was 10 mg/kg twice a day for 13 days and the result from ECG was still presented with normal sinus rhythm (Fig 3). The dosage of amiodarone was tapered down to 5 mg/kg thereafter. Unfortunately, the dog died a few days later after amiodarone dose reduction.

Interpretation

Figure 1 R on T ventricular tachycardia

Figure 2 and 3 Normal sinus rhythm

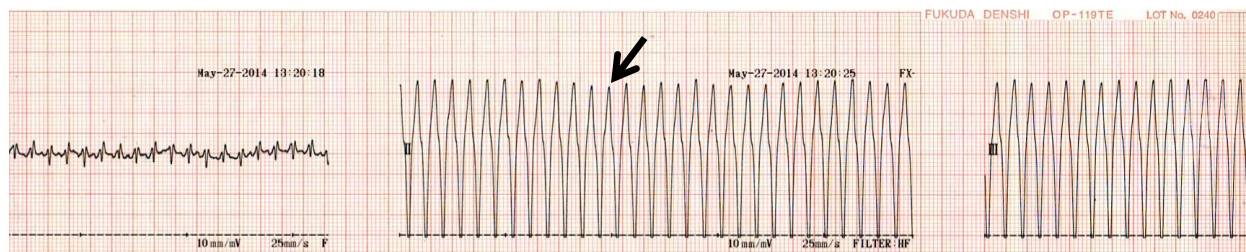


Figure 1 ECG recordings from lead I, II and III

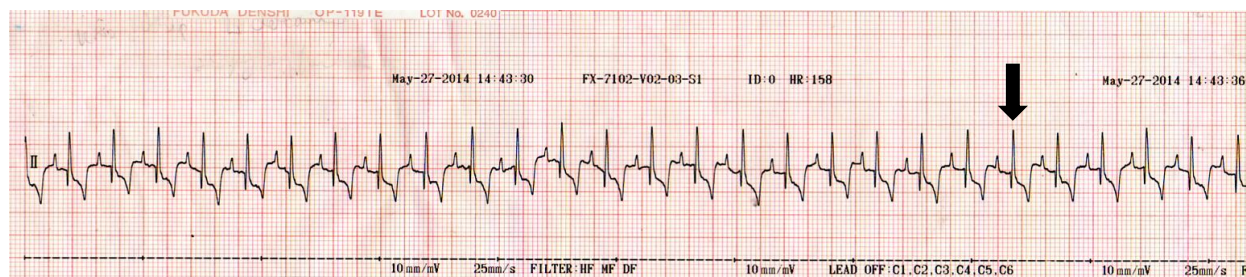


Figure 2 ECG recording after lidocaine administration

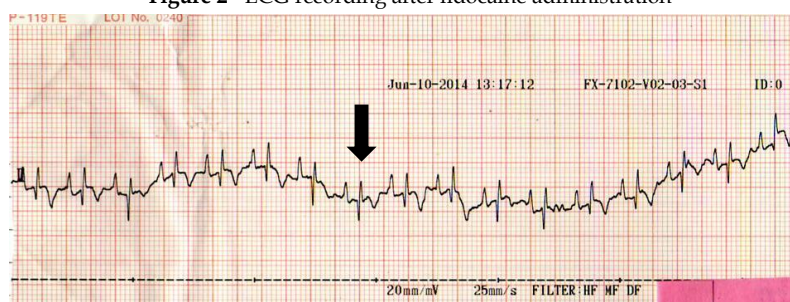


Figure 3 ECG recording 13 days after amiodarone treatment

Figure 1 showed the ECG tracings recorded in lead I, II and III. The heart rate was as high as 300 beats per minute. The shape of ECG in lead II and III showed aberrant conduction with wide waveform presented only up and down deflection. All impulses were originated from ventricle with fast rate. The continuing line connecting the ventricular depolarization wave (R) and ventricular repolarization wave (T) make this character called "R on T phenomenon" (small arrow). The depolarization is close coupled to the preceding repolarization period make the electrical impulse unstable. This type of arrhythmia is considered fatal arrhythmia which requires prompt treatment. Since the rapid heart rate with abnormal impulse conduction make the cardiac output severely diminished. The preload was also reduced due to inadequate diastolic filling time. The animal may have a sign of syncope or loss of consciousness if blood perfusion was dramatically reduced. This form of arrhythmia can cause sudden death within a few minutes without treatment.

The causes of this serious arrhythmia may be unknown in this dog. However, the thickening of ventricular wall on both sides may indicate the heart arrhythmia may be a cause or result of cardiac muscle wall thickening. No other systemic diseases were

demonstrated. The electrical instability caused by aberrant conduction or accessory pathway should be evaluated.

The antiarrhythmic drug that can be used effectively and immediately is lidocaine which is categorized as class Ib antiarrhythmic agent. It blocks fast Na channel in phase 0 depolarization. It can delay the spontaneous phase 4 depolarization. At therapeutic dose, it has minimal effects on QTc, QRS interval and atrio-ventricular conduction. Lidocaine also acts on purkinje fiber and ventricular fiber without affecting the normal cardiac tissue. It also has minimal effect on autonomic nervous system. The action is rapid with fast onset and offset kinetics. This drug acts with frequency dependent which means it can be used more effectively at high heart rate. Lidocaine blocks Na channels in their open and inactivate states and has low binding capacity in resting state. These drugs were used to treat ventricular tachycardia in order to prevent ventricular fibrillation.

Lidocaine has some adverse effects including neurological signs such as drowsiness, staggering, tremor, vomiting and seizure when giving in high dose or hypotension effect during rapid bolus infusion. Cat was sensitive to lidocaine and should be used with extreme caution. Lidocaine can be given as bolus

follows by continuous infusion for a period of time. If the cause of arrhythmia besides the heart could be eradicated, the medication can be discontinued after arrhythmia is converted to sinus rhythm. However, if the arrhythmia was still persisted, another class of antiarrhythmic agent should be introduced. In this case the ECG waveform was changed immediately to sinus rhythm (big arrow) after lidocaine administration (Fig 2). The normal sinus waveform was still maintained after 13 days of amiodarone treatment (Fig 3). Amiodarone was class III antiarrhythmic drug that can be used effectively to treated many kinds of arrhythmia in dogs and cats. Its action is to prolonged phase 3 of cardiac action potential by blocking potassium channel. Some effects

of prolong action potential duration are mediated via sodium channel effect. It also has numerous actions similar to antiarrhythmic drugs class Ia, II and IV. However, the structure of amiodarone resembles hormone thyroxin. Therefore, binding to thyroid receptor may contribute to adverse effects of this drug. Other side effects on variety organs were reported including elevated liver enzyme.

In this case, the dog ECG was maintained in sinus rhythm with high dose of amiodarone. After dose reduction during maintenance phase, the dog had sudden death which may be related to re-emerge ventricular tachycardia. Thus, high dose of amiodarone may be necessary to control this kind of fatal arrhythmia.